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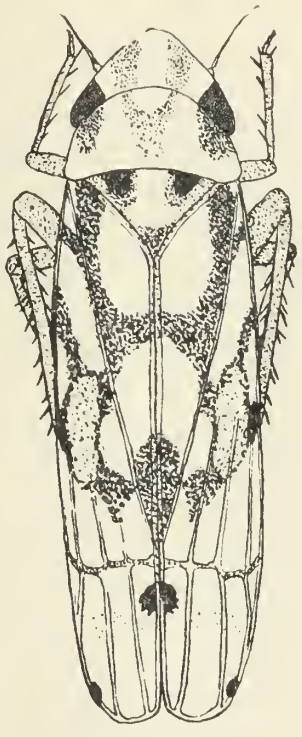
AGRICULTURAL EXPERIMENT STATION.

BERKELEY, CAL.

E. W. HILGARD, Director. BULLETIN No. 116.



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THE CALIFORNIA VINE HOPPER.

MAY, 1897.

THE CALIFORNIA VINE HOPPER.

By C. W. Woodworth.

Four things injuring the vineyards in this State may be counted as of the first importance and as doing the greatest amount of injury. They are first, the mysterious and fatal Anaheim disease, which has almost stricken from the list of the vine-growing regions of this State a large district around Anaheim and which has entirely baffled the researches of trained investigators, and which does not yield to any known method of treatment. Second, the Phylloxera, which, were it not for the protection available by the use of resistant roots, would, as it threatened to do in Europe, practically annihilate every planting of European vines. Third, the mildew, which is capable of inflicting an immense amount of injury, especially in the moister regions where the production of fruit would be practically impossible if we did not know and use the proper remedy: sulphur. Finally, the vine hopper, which is by no means intrinsically as injurious as either of the others, but because of its presence almost everywhere, and the absence heretofore of a remedy, has probably done year by year as much injury as any of the others. The Anaheim disease and the Phylloxera threaten the very life of the vine, while the mildew and vine hopper decrease the crop and make it unprofitable, which from the standpoint of the farmer is equally as serious a matter. Mildew does its greatest injury in the moister regions and in the spring of the year, while the vine hopper is more serious in the drier regions and in the summer and fall.

As has been stated above, there has heretofore been no remedy found for the vine hopper, and everything that has been tried has proven useless. The object of this article is to point out the reasons for the failure of these attempts at treatment, so that others will not waste money in a useless line of experimentation, and to suggest a line of work giving much more promise of results and bidding fair to be a solution of the problem. It will at least be useful to carefully enumerate and discuss the factors in the problem, for the solution of it will mean hundreds of thousands of dollars to the farmers of the State.

There are many important facts in reference to this insect that we are still unacquainted with, and some of the very generally accepted ideas are entirely erroneous. We will first discuss the facts in the life history of the insect and its relation to the grape vine, and then consider the remedies.

THE HOPPERS IN WINTER.

This is a point in the life history about which there is the greatest difference of opinion among farmers, and the most erroneous ideas exist. The commonest of these errors we will enumerate and discuss.

The insect does not pass the winter as an egg. In the spring there is no such a thing as hatching out. Warm weather cannot aid nor cold weather retard their hatching, because they do not hatch at that time of the year. The insect that occurs in the spring is not a young insect. Everything done in the winter with the idea of destroying the eggs is done on a wrong theory, for there are no eggs to destroy at that time. A great deal of time and money has been spent every year in acting on this erroneous theory.

The insect does not pass the winter in the ground, in any form, at least to any extent. The ground would be the last place to look in the winter for living leaf hoppers. The idea probably arose because some other common insects, with an entirely different life history, do pass the winter in the ground (the grasshopper for instance, in the form of masses of eggs), and partly because dead hoppers can often be seen on the ground in the fall in considerable numbers. Whatever is done in the winter to the soil will not have any effect on the hopper.

The insect does not pass the winter about the vine, in any considerable numbers. Some suppose the bark is full of eggs that hatch in the spring, and others think the insect is hiding beneath it. Both ideas are entirely wrong. On the one hand no eggs pass the winter, and on the other the insects could be found if they were actually hiding there ; but in truth only an occasional one can be seen. Some scale insects may be killed by spraying the plant in the winter, but the vine hopper is a different kind of insect and the money which is spent every winter, somewhere, experimenting with the vine hopper, is that much thrown away.

The insect does not pass the winter in the fallen leaves to any great extent. This is the most wide-spread idea in this State and is based, not on observation, but on statements in books which refer to the eastern insect and the eastern winter, and even there is not strictly true and as regards the condition here is absolutely false. A good many hoppers may be found on the fallen leaves in the fall, but they do not pass the winter there and all that try to do so die. With our warm winter they must have food. They cannot sleep over winter as they could if it were colder. A few may be found anywhere in the winter even on the dead leaves, but they cannot stay there all winter. Much money has been spent every winter in the destruction of leaves, and those that have tried

the experiment have been at a loss to know why they produced no practical results, and have blamed their neighbors for not doing likewise, thinking that the neighbors harbored the insects that attacked them in the spring.

During the winter the insect leads a somewhat active life, feeding on every variety of plant that is green. They may be found anywhere at any time. Every insect that attacks the vine in the spring has been present in the neighborhood of that vine all winter as an adult active insect.

Winter is a very critical time in the history of these insects. In the fall they may be found of all ages and sizes, from the egg to the aged perfect insect, but the winter climate is so fatal that all the eggs and young die, and of the adults only the youngest and most vigorous survive. If the winter is more than usually severe, they will be very much reduced in numbers and do but little injury, and that late in the season, when they will have increased sufficiently in numbers. But if on the other hand the winter is favorable to them, as the past winter has been, they will begin in large numbers and, if nothing happens to check them, may do very great damage.

During their winter life the insects, though somewhat active, are by no means so active as in the summer, and they are therefore much less conspicuous. The injury they do to plants is also very slight. They only take enough food to meet their present needs and the plants they attack generally suffer scarcely at all. During the colder weather they are especially inactive ; many fall from the plants and lie on the ground, and are quite difficult to find.

While the insects feed on all varieties of plants, they have decided preferences for some, and will be found much more abundantly on such plants. Often toward spring the leaves will show the effects of their attacks by the small paler spots characteristic of the work of insects of this group.

THE HOPPERS IN SPRING.

With the coming of the warmer weather in the spring, the needs of the insects increase not only on account of the more active life, during warm weather, but because food must be taken with which to produce their eggs. When the leaf hoppers become adult the sexual organs have scarcely more than begun to develop, and they require a great deal of food for this purpose. Those whose sexual organs had developed considerably in the fall were not able to survive the winter because of that drain on their vitality, and only those in which these organs were not growing, are alive in the spring. These organs with the return of warm weather start to grow, and as this sharpens the appetite of the insects, they become more restless and migratory. As soon as the grape-vines leaf out, they will find the hoppers waiting for them.

How they feed. By carefully examining the under side of the body with a microscope, one will notice between the six legs lying on the breast and projecting backward from the head, a rather thick pointed organ which is capable of being bent out nearly at right angles from the body. This is the proboscis or sucking-tube by means of which the insect obtains its food. The method of inserting it can be observed by lying down under a vine and remaining quiet a little while till the hoppers get accustomed to your presence, when by watching an insect that has alighted in such a position that one gets a side view of it, he may see the whole process. The insect first, by straightening its legs, raises itself from the plant a distance about equal to the length of its proboscis. The proboscis will then be seen to bend down till the tip touches the plant and then the insect draws itself towards the leaf, forcing the proboscis in its full depth. The insect comes thus much closer to the leaf than it would ordinarily stand. The food is sucked up through the proboscis, and includes not only the juices of the plant, but also the more solid substances in the cavities of the leaf, the pale spots being due to the removal of the green bodies of the leaf.

The injury to the plants. Whereever the beak is inserted the skin or cuticle of the leaf, which protects the leaf from drying out, is broken and the leaf is that much weakened, or requires that much more water to keep it in healthy condition. Some of the substance of the leaf is also removed and the leaf has less of the green bodies which are essential in the manufacture of the food for the growth of the plant, but these are not as important as the loss of water and the injury to the cuticle which makes a continual leakage. The injury from loss of water is twofold; first, the only condition under which growth is possible, is that the water in the growing part be under tension, that is, that it be supplied faster than it is used, and if the leakage prevents this tension, no growth can take place no matter how much food may be present. Secondly, when the tension is removed the leaf undergoes changes which we call ripening, which finally result in the death and dropping of the leaf. Now every leaf costs the plant something in its production. The leaf is a factory for food, and unless it remains on the plant long enough to manufacture more than it costs it is a loss to the plant. The leaf hopper is a very small insect, and it would require a great number to be as much of a drain on the vine as the production of a berry if, like the fruit, they merely took their food from the plant without otherwise injuring it. But the hopper, while taking nowhere near as much food from the plant as the fruit does, still is able to stop the growth and kill the leaves. It will be seen that this injury is produced only when the loss of water is large enough to seriously reduce the tension. In the drier regions and in the drier part of the year, therefore, the injury is most severe. Under favorable conditions it might amount to nothing.

There is a special condition in the spring of the year, when an injury occurs of a somewhat different nature. Usually the hoppers do not attack seriously the very young leaves, but in the spring, if the vines come out late or the insects are in unusual numbers, or if the weather

is warm, favoring their early and active migration to the vines (all of which conditions occurred this spring), the hoppers may attack the expanding leaves and so injure them, especially at the veins, that they never fully expand; and the leaves ripen very fast and fall before they are hardly replaced by new foliage. In the meantime the first fruit buds appear and, because of this condition of affairs, fail to set fruit. This occurs only early in the spring and not very commonly with this species, but more often in the case of the large leaf hopper that is found along the coast.

Egg-laying. The eggs begin to be laid by the time the first buds appear and are laid continuously all the rest of the season. At the end of the abdomen of the female there is a spear-like ovipositor concealed between two large plates, which form quite a third of the abdomen. This ovipositor is nearly as long as the proboscis and is inserted into the plant in much the same way and the egg is forced through it into the plant. Eggs are laid only in the soft new growth, on the leaves or stems or tendrils. The insects produce only a single egg at a time, which is relatively large. They continue a long while, producing them certainly till after their children are grown and have begun to lay eggs. There seem to be no data as to the number of eggs produced nor the length of time it takes an egg to hatch.

The young insects. The young insect on hatching crawls out into the open air and making its way to the nearest leaf takes a position on the under side, preferably near a vein, and leads a very quiet life. It obtains its food in the same way as the adult and resembles it in most particulars, but is of course without wings. Though it is capable of jumping, it must be disturbed a great deal before it can be made to do so, preferring to run away or to hide next to a vein. This retiring disposition makes it a very inconspicuous insect. As it grows it goes through a set of moults as do other insects, finally obtaining wings as it becomes adult. The number of moults that the insect passes through has not been determined. The injury done by the insects while young does not seem to be very large as compared with that done by the adult. Their sluggish habits and shorter life requires less, as well as the fact that they have to provide only for their own growth.

THE HOPPERS IN SUMMER.

The numbers in the spring gradually increase until practically all the hoppers have left the other plants and accumulated on the vine; then they gradually decrease as the more feeble ones die, until the beginning of summer when the first brood of young ones begin to reach maturity and augment the numbers. This is about the first of June. From that time on they continue to multiply as long as the season lasts, and at any time the insects can be found in all stages of development.

The characteristic appearance of the leaf affected by these insects now becomes everywhere apparent. Besides the pale mottlings that have already been mentioned, one may notice, especially on the under side where the insects chiefly stay when not on the wing, many small spots

of all shades from brown to black. These spots are the excrement of this insect. Similar spots are made by other insects of this order and by the true thrips. The worst affected leaves gradually die and fall, making the vines almost bare when they should be dense with leaves. When this condition is produced, the fruit is of an inferior quality. Especially is it lacking in sugar and other solid contents, and therefore dries into small raisins, or makes a thin watery must for wine-making.

REMEDIES.

Under this head we will treat the various means that have been employed or suggested for preventing or mitigating the injury from leaf hoppers.

Sheeping the vineyard. This is one of the favorite remedies and is depended on, more because it is supposed that it ought to work than because any one has ever had good results. There is a natural variation from year to year with this as well as with all other insects, and as one is most likely to try a remedy of any kind during or just after a bad season, it is not surprising that there is considerable testimony to the effect that good results follow sheeping. No one who has carefully compared adjacent vineyards where sheeping and not sheeping have been employed, will be able to say that there is an appreciable difference in the fields. We are not discussing the merits or demerits of turning sheep in the vineyard to eat off the leaves; but as far as its effects in reducing the numbers of leaf hoppers, there is not one particle of reliable evidence in its favor. The theories for sheeping are many but all untennable. Some hope to destroy the eggs and young, and this in a measure they do accomplish; but they do not realize the fact that, if left alone, all of these would die during the winter; and that the only ones destined to pass the winter are the adults which the sheep do not destroy but cause to take wing.

Others have the idea that by feeding the leaves the insects will be unable to find a suitable place to pass the winter; whereas to destroy their wintering place it would be more effectual to let the vineyard alone and to cause the sheep to brouse off all the citrus and other evergreen trees, and all the grass and weeds along the ditches, — indeed to make the whole country bare and to keep it so all winter. One would starve the sheep to death before he would the bugs, and in every respect the method is impossible and ridiculous. Again others think that the sheep would crush those in the ground. As a matter of course there are none in the ground and there is no reason to think that they would be crushed if they were there. The only place that is beaten hard by sheep are the paths they follow and the place they sleep at night. A few may be crushed on the surface, but a hopper so feeble as not to be able to get out of the way of the feet of the sheep could not withstand the winter.

Destroying the leaves. Many farmers have gone to the trouble of gathering and burning the leaves, or of plowing a furrow and raking them in and burying them. The reasoning is about the same as those in favor of sheeping. Farmers are not alone in this matter, for entomolo-

gists everywhere have repeatedly advised such a cleaning up to destroy what were, or what were supposed to be, hibernating places. These recommendations appear in practically every book treating on remedies for insects, but it is a fact that even in cold climates, where insects do hibernate, there has never been a single reliable experiment on an insect of any kind that substantiates this method's claim to practical utility. We do not mean that no experiments have been tried, but that not only have no economic results been produced, but all results have been either negative or unreliable. In our climate, with hardly any true hibernation and an insect that does not hibernate, this method can only be futile of results.

Plowing and rolling. This can only be done in the winter, after pruning, or in the spring, before the growth is far advanced. By the time the pruning is through with there will be very few of the hoppers in the vineyard that are vigorous enough to get away, and it is doubtful if those that still remain include many that would be likely to pass the winter successfully. The general idea of winter plowing and rolling is based on the supposition that the insects are in the ground and could be reached by such methods. In the spring, after the hoppers have attacked the vines, it is the practice of some to jar the insects onto the ground in the morning, when they will not attempt to return to the vine, and turn them in with plow, disk, or cultivator, or harrow and sometimes follow with a crusher or roller; and there is no doubt that in this way some of the insects, perhaps quite a good proportion, will be destroyed. We do not think that the results attained will in any way justify the expense, and the method can only be applied during the night or on a cool morning. Unless the cultivation is necessary in itself it could not be thought of as a remedy for the hopper. There may be opportunity of employing it economically, however, but alone it can never be effectual, as it can only be used early in the spring.

Winter spraying. This luxury has often been indulged in with endless variation as to detail. Often the bark has been carefully stripped off the stumps before the spray was applied. Almost every kind of spray has been tried and, of course, never with brilliant results. Often the farmer will say that he thinks it did some good, but none think that it has paid for the trouble. The fact is that it had no effect whatever on the hoppers, and as far as the hopper is concerned, all the money spent in this way is wasted.

Summer spraying. While winter spraying is the most useless thing that can be done, spraying in the summer, when there is something in the vines to kill, is an effectual process. All that can be said against it is the difficulty and cost. Indeed this is so great that it is doubtful if it is really practicable. There is a great difference between effectiveness and practicability. Nothing is practical unless it pays. When it is said that spraying is effectual, the statement should be modified to this extent. The insect is so active that it is impossible to prevent many from escaping, and they are so difficult to wet that it is necessary to use a very strong and penetrating wash like the kerosene emulsion, to get even fair results. In the spring it is quite easy to spray, as the

material used can be taken through the fields on a truck, but as soon as the vines cover the ground it becomes another matter. Then the use of knapsack sprayers seems to be the only way to apply a spray. The necessity of spraying from below increases the difficulty and expense of such a treatment. The only spray that does any good is one that will kill. It is not possible, for instance, to make the vines distasteful to the hopper and so make it starve to death. Many things have been tried for this purpose, but nothing has ever been, and probably never will be, found to do it with this insect or any other.

Jarring. Jarring is one of the commonest remedies tried in the spring and under some conditions it is one of the best. The sketch, Fig. 1,

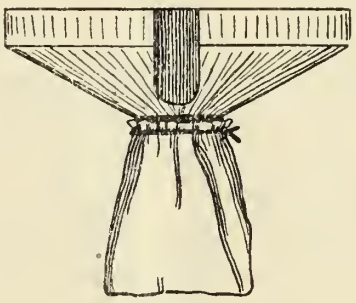

Fig. 1.

given herewith, is one that has been used in Europe for a different kind of insect, and has been recommended by European authors for their vine hopper, which is related to our insect, but has never been abundant enough to really need a remedy. It consists of a tin funnel with a notch to enable it to be held under a vine and a cloth bag tied to the bottom to hold the hoppers. In the next sketch, Fig. 2, is shown a

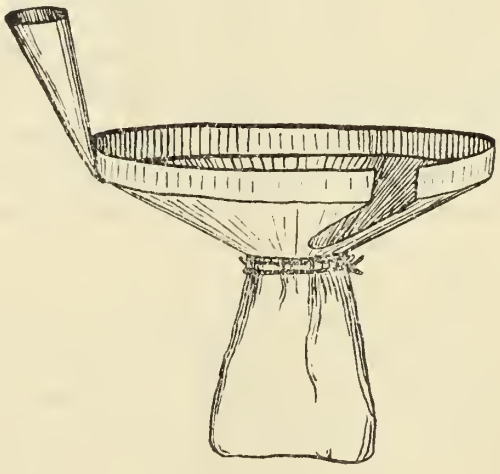

Fig. 2.

modification which differs in the addition of a conical tin handle, in which may be inserted a short stick if it is desired to increase its length. About a foot and a half in diameter will be found a convenient size. Any tinner can readily make the funnel.

In the work in this State the favorite form has been something like a large scoop. It is generally made broad with a notch in the edge, and one held on each side of the vine while it is jarred, and the insects that fall on the scoop are, from time to time as they accumulate, poured into a vessel containing water and a little kerosene. The accompanying sketch, Fig. 3, gives a style of these scoops made of a single piece of

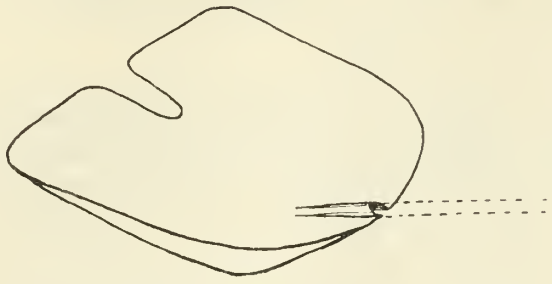

Fig. 3.

tin. A part of one edge is so bent as to fit a handle. The corners are rounded and a notch is made in the edge opposite the handle. Two men proceed up a row of vines placing the scoops below the vine and one of them jars the vine with a stick.

The success of jarring will depend on preventing the hoppers escaping from the scoops and can only be used when the hoppers will fall well. It likewise cannot be used after the vines attain considerable size: therefore this method alone cannot be depended on, however well it may work in the spring.

The hopper dozer. Great ingenuity has been displayed in the designing of hopper dozers. By this term is meant any contrivance against which the insect may be made to leap or fall and which will cause their death. Generally they are coated with a sticky substance on the principle of a fly paper. Many have been made on the principle of the scoops for jarring, but where tried have generally been replaced by the scoop without the sticking mixture. Others which work very well have been shaped like a bell jar; this kind can only be used during the hotter part of still days, while the insects fly well. Both of these forms are only intended for use in the spring while the vines are small, and the latter only on short-pruned varieties. They both are troublesome to recharge with the sticking mixture and probably have been discarded in every case after the first trial.

There is another form that has been used successfully in the eastern States on a small scale, and which promises to be much more satisfactory for use here than any kind as yet tried in the State. It consists simply in a plain palm-leaf fan. The idea is to have a can of the sticking mixture large enough to dip the fan into, and arming each man with a stick with which to jar the vines, and a fan to catch the insects with, have them go rapidly through the vineyard, from vine to vine. In the morning while they drop, it may be well to work the men in pairs thus: Give

one man two fans and the other a fan and a stick. When they come to a vine the three fans will be held below the vine, touching the trunk and overlapping each other. The vine is then jarred and the insects caught. As the day gets warmer and some of the insects fly, those that drop are first caught and then the fans at once swung catching those in the air. After they cease to drop the men can work independently, though even then it may be well to continue to work in pairs. The sticking mixture may be kept at the end of the rows. This method is applicable all summer, but even this can only be used for hoppers on the wing after the vines are large.

The net. The use of the insect net has not been seriously thought of as a means of combatting this insect on a large scale until this year, as far as we are aware. Experiments seem to indicate that it will prove thoroughly practical. The form of net that we prefer is made as follows: For a net a foot in diameter take a piece of wire forty inches long, bend about an inch and a half of each end at right angle, and then bend the whole wire into a hoop bringing the bent ends parallel. Make a tin ferrule about six inches long, increasing from one quarter to about three quarters of an inch in diameter at the larger end. Solder the ends of the hoop into the smaller end and the hoop is complete. The ferrule serves as a handle, or when a longer handle is needed a stick may be inserted into it. The bag of the net is made of a yard of cheese cloth. Fold the cloth so as to bring the selvages of one side together and sew along the selvage. This will make a conical bag. Now trim the cloth so that the edge is everywhere a half a yard from the point of the bag. Gather the edge of the bag on the hoop, making a hem, and the net is complete. [Fig. 4.] A net, having a diameter of a foot and a half may

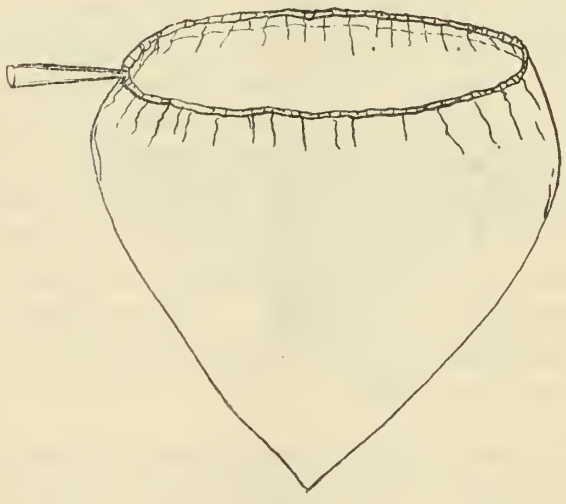

Fig. 4.

be found more useful, in which case a wire about sixty inches long, and four feet of cheese cloth, will be needed, but otherwise it is made in the same way.

In using the net one first jars the vine and, as the insects fly, a few strokes with the net will catch the great majority of them, if skillfully done. With a net of this shape the insects will all accumulate in the tip and can be quickly crushed to death with the hand or emptied into water and kerosene if desired. The practicability of the method will depend on the skill of the workmen, but the skill is easily acquired and most every one will get the idea at once. The nets could be used early in the morning in the same way suggested in the case of the fan hopper dozer. The net is equally as rapid as the fan, does not require the sticking mixture and is therefore preferable; though it may require more skill in handling and therefore with some men be less satisfactory. Like the fan method the net may be used all summer. The two comprise the only methods (with the possible exception of spraying) which are at all practical for summer use, at least with the Californian methods of culture.

TREATMENT.

We have thus far considered the remedies available for treating the vine hopper; there yet remains to be discussed the theories and program of treatment. Almost every kind of remedy that has been suggested for destroying insects, has been tried for the leaf hopper without sufficient success to justify its continuance, and either we must wait for some brilliant discovery and in the meantime allow the insect to be uncontrollable, or we must radically change our theory of treatment. In all the experiments in this State the idea has been to destroy the insect in the winter or spring and to depend on that for the protection of the crop through the rest of the year. The desire has been to exterminate the insects or approach that result as nearly as possible; but that has proven impracticable. It seems about time to stop the war of extermination and turn our attention to another solution of the problem which gives more reason to hope for success.

The new theory of treatment that is proposed is based on the fact observed by all that a small, or even a considerable number of hoppers does not appreciably injure the crop. Of this fact every grower in the State can bear witness Good crops can be produced in spite of the hoppers, and it is only their excessive numbers that are injurious. The problem can be reduced then to this question: Is it possible to reduce the numbers in a field below the danger mark? It must be possible to do so at any time and at a small expense. The question then arises: What is the danger point? This cannot be definitely answered, but observations during years when there is the greatest loss and during those in which the loss is trifling leads us to believe that if the number could be reduced fifty per cent. in the worst years, the injury would be avoided. If it is true that such a reduction would prevent the injury, the question is, Can fifty per cent. of the insects be cheaply destroyed?

According to the best estimate we could make by actual trial in the field, of the effect of the use of the net in the spring, it appeared that

a much larger percentage than that could be destroyed — nearer ninety per cent., and this too while working at a rate of about five acres a day. About half of a gang of men green hands at the business, part white and part Chinese, did almost as well as one skilled with the net. At the rate of wages they were getting, the cost per acre would be between fifteen and twenty cents. This makes it a wonderfully cheap process. If it cost twice as much and had to be done a dozen times in a year, it would not begin to cost as much as the loss to a crop in a bad year. It seems to have been proven by actual test that a good percentage of the hoppers can be taken and killed by the use of the net and at a cost per acre that is nominal. There yet remains to be seen whether the vineyardist can develop a judgment that is to be depended on as to when the insects are approaching the danger point, and to set the nets going. According to this new theory of treatment it would appear that we have the true solution of the problem and that the net or the palm-leaf fan are the means giving the greatest promise.

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